

Mycobacteriosis and wasting disease in Guppies

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As its name suggests, "wasting disease" is a chronic condition that causes fish to become progressively thinner and weaker, typically over a period of weeks or months. There are many possible underlying causes for this gradual loss of body mass in fish, for example: poor nutrition; heavy worm infestation; old age. Probably the most common cause, however, is a mycobacterial infection.

What are mycobacteria?

These elongate, rod-shaped bacteria belong to the genus *Mycobacterium*. They reproduce very slowly (~ several hours per division). They are often termed "acid fast bacilli" (AFB) due to the characteristic way they stain with laboratory dyes that are used to help identify different types of bacteria.

Mycobacteria are ubiquitous organisms in that numerous species occur in soils and water bodies throughout the world. Some have taken up a parasitic life-style, being important pathogens of humans (e.g. leprosy and TB) and other animals, including fish.

Mycobacterioses in fish

The important fish-pathogenic species are *Mycobacterium marinum*, *M. fortuitum*, and *M. chelonae*, although other mycobacteria are also known to cause pathology in fish. The disease they cause is sometimes referred to as "Fish TB" but this is not the same disease (or same species of *Mycobacterium*) that causes TB in humans - so do not be alarmed!

Mycobacteriosis has been described as "the most common chronic disease in tropical aquarium fish" (Astrofsky et al., 2000. *Comparative Medicine*, volume 50: pages 666-672). Certainly, it is a disease problem that affects poeciliids and other ornamental fish held in private and public aquariums, and on ornamental fish farms. Our knowledge of mycobacterial infections in wild fish populations is less well understood. The disease known as "Poeciliid Granulomatous Disease" (PGD), reported in wild poeciliids (e.g. *P. mexicana* and *Xiphophorus helleri*), may possibly be linked with mycobacteria, but we aren't totally sure.

How mycobacteria enter the aquarium

The most likely source of infection is via infected fish or their transport water. Apart from the water itself, any faeces present in the transport bag could harbour mycobacteria if these wastes were evacuated by an infected fish.

We know that mycobacteria have occasionally been isolated from public water supplies (mycobacteria exhibit some resistance to chlorine-based disinfectants), however I have not encountered reports of fish-pathogenic species having been isolated from tap water - so the jury is out on that one. (I'd be grateful to hear of any documented cases.)

Another method of spreading mycobacteria from tank to tank is via nets or even your hands. This is something to bear in mind if you have several tanks of guppies.

Finally, an important route of infection that is relevant to guppy breeders is "vertical transmission" where the mycobacteria spread from one generation to the next. This occurs when an infected mother fish (e.g. pregnant guppy) unwittingly passes some of her mycobacteria to her developing fry. The unfortunate babies are born already infected with mycobacteria. Incidentally, mycobacteria can also spread vertically in egg-laying fish.

Symptoms in fish

It is thought that fish generally acquire mycobacteria via the oral route, such as when foraging on the faeces, or dead bodies, of infected tank-mates, or on detritus that may harbour free bacteria.

Mycobacterial infections often cause no obvious symptoms in the fish. Even where symptoms do arise, they are non-specific and vary in severity. Symptoms include gradual weight loss leading to a sunken belly, stringy faeces, haemorrhaging and ulceration of the skin, poor coordination, dropsy (bloating), pop-eye, and sometimes deformity of the backbone. Of course, these symptoms can have many other causes, such as infection with other types of bacteria, or maybe a viral disease, so we can never be 100 per cent sure that they reflect a mycobacteriosis. A detailed internal examination, including bacteriological tests, would generally be necessary to confirm the link between observed symptoms and mycobacteria - and would require submitting the fish to a specialist lab.

Fortunately, mycobacteriosis doesn't spread rapidly like some infections do (e.g. whitespot disease). If mycobacteria are present in your stock then you may find that just one or two fish develop wasting disease every so often, such that you end up with a few fish in various states of this condition. Within the same aquarium may be a majority of perfectly healthy looking individuals. Whether some of the healthy fish are harbouring mycobacteria is impossible to tell (mycobacteria have been isolated from ornamental fish that appeared in perfect health). One thing is for sure, strong healthy fish that are kept under optimal water conditions will have a degree of protection against these, and other, pathogens.

Pathology of mycobacteria

If mycobacteria gain entry into the fish, they may spread to other parts of the body, including the skin and internal organs such as the liver, spleen and kidneys. The invading mycobacteria will be prone to attack by the fish's immune cells, and this can result in some being imprisoned inside a mass of host inflammatory tissue known as a "granuloma". The presence of granulomas, which appear as small pale lumps inside the kidneys and other organs, strongly point to a mycobacterial infection, although other pathogens (including *Nocardia* bacteria) can also elicit granulomas. Unfortunately for the fish, granulomas may rupture, so freeing the mycobacteria.

As one might predict, the damage caused by mycobacteria can be widespread. Mycobacteria within the skin may cause ulcers and bruising (haemorrhaging). Others may enter damaged blood capillaries, and travel to other parts of the fish's body via the circulatory system. Those major organs that filter the blood, such as the kidneys, spleen and liver, will be prone to invasion by the blood-borne mycobacteria. Kidney infection can lead to osmoregulatory problems and accumulation of fluid in the fish's body (leading to dropsy) and behind the eyes (causing pop-eye). Mycobacterial infection of the gut will reduce the fish's ability to process ingested food, leading to chronic weight loss, and stringy faeces. Typically, the increasingly weakened fish will ultimately lose the battle and die, but this can take weeks or more.

Treatments

Unfortunately, mycobacterial infections are notoriously difficult to treat. Bear in mind that mycobacteria tend to reside deep inside the fish's tissues and organs, some being imprisoned inside host granulomas, making it very difficult for water-borne medications to reach them. It is little wonder that over-the-counter (OTC) remedies fail to work. Even antibiotics (from the vet*) offer only limited success**. This is partly because mycobacteria are resistant to many antibiotics that are used to treat fish. Also, mycobacteria are "slow-growers" and this delays the action of antibiotics.

*In some countries, but not the UK, it is legal to buy antibiotics without a veterinary prescription.

** A combination of antibiotics (e.g. doxycycline and minocycline) has been used to treat high "value" fish, with limited success.

Other control strategies

In the absence of reliable treatments for mycobacterial infections, the guppy keeper may be left with some stark choices should an outbreak be suspected. My personal strategies are as follows, but I am always grateful to hear how others deal with suspected cases:

If just a single guppy develops signs of wasting disease, then isolate it, just in case it has mycobacteriosis or some other infection. Try treating it with a general anti-bacteria remedy. Keep a check on the remaining stock. If all others remain well over the next few weeks then hopefully you don't have a mycobacteria problem.

If two or more fish develop signs then the whole stock should be considered "suspect". (You may wish to open up the dead fish and look for granulomas within the organs - seek advice if you are not sure what to look for.) In my view, the only safe option is to keep the stock in strict isolation, and this may mean for ever if wasting symptoms continue to arise within the population. In such cases, you may wish to separate the sexes to prevent them from breeding, given the risks of vertical disease transmission, discussed earlier.

Badly affected individuals should be euthanized to prevent further suffering.

There is some evidence that UV irradiation (UV sterilizers) might help. Of course, UV cannot kill mycobacteria that are already present in fish, but may help lower the levels of mycobacteria in the water, so reducing the risks of transmission (see Diana Walstad's excellent article on fish TB in *Tropical Fish Magazine*, June 2007 issue, pp. 36-41). Personally, I wouldn't go to the expense of continuously running a UV unit on every guppy tank. But if you are a serious guppy breeder then consider investing in a portable UV unit that can be put to use as and when necessary.

Quarantine

Despite its limitations, quarantine is strongly advised for all new guppy purchases, regardless of their source. There are no hard and fast rules concerning the period of quarantine, but obviously the longer the better. I'll stick my neck out and suggest 3 weeks minimum. Be choosy as to the source of your guppies. Sadly, some mass-farmed guppies are in poor shape and may harbour disease.

Other preventative measures

As with many bacterial diseases, the risk of an outbreak is increased under sub-optimal aquarium conditions. Factors such as poor water quality, overcrowding and other stressors will make guppies more prone to mycobacteria and other infections. Don't overlook food quality - a well-balanced diet is vital for maintaining your fish's immune system.

Human mycobacterioses

I mentioned earlier that fish TB is not the same as human TB (e.g. classical pulmonary tuberculosis). However, I should mention that some fish-pathogenic mycobacteria can cause skin infections (notably of the lower hand) in humans, albeit rarely. As a precaution, wear

water-proof gloves when handling fish (or their water) that are suspected of harbouring mycobacteria. I would in any case recommend wearing gloves if you have cuts to your hands. (Obviously, don't don gloves that have been used to do the washing up, even if rinsed afterwards - fish don't like detergents in their water!). If you have any concerns about a skin infection, consult your GP.

About the author: Dr Peter Burgess is a keen fish hobbyist and a member of the British Livebearer Association. He studied parasitology for his first degree and was later awarded an MPhil for his research on human mycobacterioses. Peter went on to study fish biology and aquarium fish diseases for his MSc and PhD, and is now a part-time lecturer in Aquarium Sciences at Plymouth University in England. In addition to his writing and consultancy roles, he heads up the Aquarian® Advisory Service. In 1995, he and a colleague (Stan McMahon) led the Aquarian® expedition to Trinidad to survey and collect unique wild guppy populations for conservation breeding programmes.

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